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Versar INC.

SITE SUMMARY FOR IRFNA/MAF-4 DISPOSAL SITE, VIEQUES ISLAND (SITE NO. 3)

Prepared for:

Atlantic Division
Naval Facilities Engineering Comman
Norfolk, Virginia 23511

Prepared by:

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Springfield, Virginia 22151

Versar Job No. 5295.3

July 25, 1991

Versar INC.

SITE SUMMARY FOR IRFNA/MAF-4 DISPOSAL SITE, VIEQUES ISLAND (Site No. 3)

INTRODUCTION

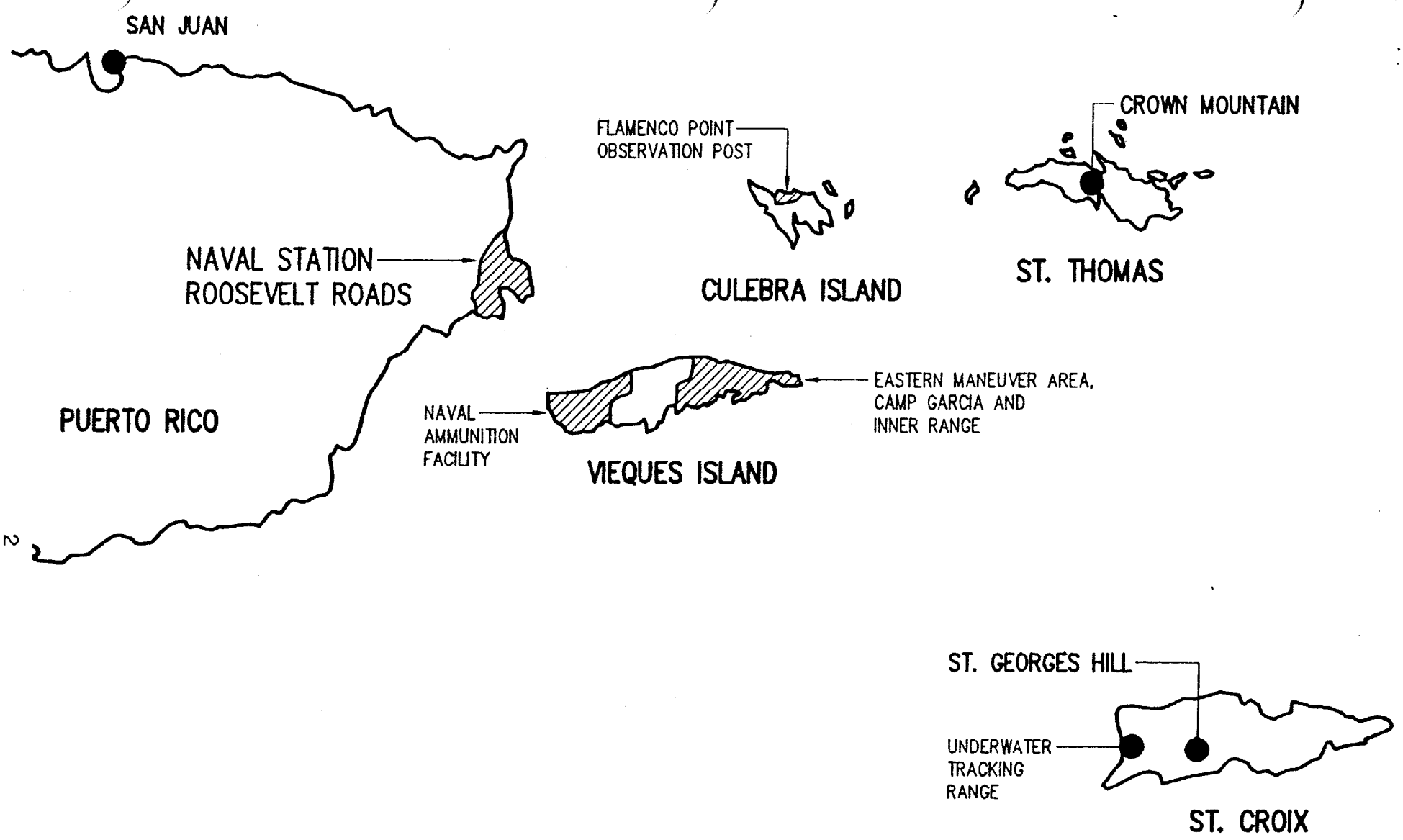
The U.S. Naval Facilities Engineering Command (NAVFACENGCOM), Atlantic Division has contracted Versar, Inc. to provide environmental services to the Naval Station (NAVSTA) Roosevelt Roads, Puerto Rico. As part of these services, Versar has prepared site summaries for Site 3, IRFNA/MAF-4 Disposal Site, Vieques Island, Puerto Rico, and other sites at NAVSTA Roosevelt Roads. This site summary has been developed based on the findings of the Initial Assessment Study (IAS) prepared by Greenleaf/Telesca (1986), and Confirmation Study prepared by Environmental Science and Engineering (1988).

This site summary has been prepared to highlight the results of previous investigations, briefly discuss fate and transport potential of site contaminants, and determine the need for further investigation, if warranted. If no further action is required for the protection of human health and the environment, the summary is intended to serve as part of the Navy's decision document to support the no action alternative.

BACKGROUND

In 1975, Weapons department personnel at NAVSTA Roosevelt Roads disposed of 25 AQM-37As, which were stored in a bunker on the island of Vieques (Figure 1). The AQM-37A is a target drone capable of supersonic speeds. The 25 drones were found to be leaking. The fuel used by these drones is a binary fuel composed of two highly reactive components. The fuel consisting of 71 pounds of mixed amine fuel (MAF-4) and 211 pounds of inhibited red fuming nitric acid (IRFNA) per drone, was drained into a "quebrada" (a Puerto Rican term for a sharp ravine of an intermittent stream) at the low spot in the road near Building 422 on the Naval Ammunition Facility (NAF), Vieques. A maximum of 1,775 pounds of MAF-4 and 5,275 pounds of IRFNA were emptied into the quebrada (a dry stream bed), and the drone bodies were disposed of by dropping them into the ocean off a deep water ledge, where other ordnance items had been disposed of in the past.

The exact composition of MAF-4 fuel cannot be released in this report. However, this mixed fuel is similar to hydrazine in composition. Red fuming nitric acid is 86 percent nitric acid, 6 to 15 percent nitrogen dioxide, and less than 5 percent water. Hydrazine-like compounds are strong reducing agents and they are very reactive (Condensed Chemical Dictionary, 1977).



2

LEGEND

- CITIES
- U.S. NAVAL FACILITIES

NAVAL STATION ROOSEVELT ROADS

DESIGNED	FLOWERS	DATE 12/13/90
DRAWN	CAROLINO	12/14/90
CHECKED		

FIGURE 1
LOCATION OF ROOSEVELT ROADS
NAVAL STATION

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6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703) 750-3000

APPROVAL	DATE
PROJECT NO. 5295.001.01	SCALE: AS NOTED
DRAWING NO. FIG1.DWG	FIGURE 1

Hydrazine weighs 8.4 pounds per gallon, and nitric acid weighs approximately 12.2 pounds per gallon (Condensed Chemical Dictionary, 1977). Using the weight of fuel known to have been spilled, the volume of the fuel spilled is approximately 645 gallons. In view of the relatively small volume of material released, and no physical evidence of harm, no soil sampling in the spill area was proposed.

Residual fuel components from the drones at the NAF on Vieques could potentially migrate by both surface water and ground water. The most likely pathway for surface water migration is runoff in the quebradas, which are intermittent drainage areas (Figure 2). Runoff in the northern quebradas near Site 3 would enter the Vieques Passage. Runoff in the southern portion of the quebradas would enter the Caribbean Sea. Other potential pathways include ground-water migration to the areas of mangrove swamp that are subject to tidal inundation.

The quebrada where the disposal took place is downgradient of the surface recharge area and in the opposite divide for one of the few naturally occurring springs on Vieques that flows year-round. The spring is currently used by the Cooperativa de los Ganaderos, a livestock raising cooperative, and is supplemented by water obtained from the Vieques water supply pipeline. The spring is frequently used by cattle, horses, and various birds and other wildlife, but is located 2,000 feet downgradient of the divide separating the spring's ground-water system from the ground-water system where fuel materials were disposed. When the cooperative wants to roundup the livestock, which generally occurs during the dry season, all supplemental water sources are shutoff so that the livestock are attracted to the spring where they can be easily captured.

Site 3 and the spring used by the cattlemen's cooperative are located in a narrow valley, the Valle de Resolucion, that runs northwest by southeast at the western end of Vieques Island. A drainage divide exists within this valley (Figure 2). Northwest of this divide, surficial streams flow towards Laguna Kiani. On the southeast side of the divide, all streams drain toward Laguna Playa Grande.

Bedrock below the Valle de Resolucion is composed of deeply weathered plutonic rocks, largely granodiorites and quartz diorites. Igneous rocks such as these initially have no porosity and permeability. The larger valleys of Vieques Island, such as the Valle de Resolucion are blanketed by alluvial deposits consisting of clay, silt, sand, and gravel derived from the parent igneous rocks. The soil near Site 3 consists of a relatively fine grained clay loam.

Site 3 and the spring used by the Cattlemen's Cooperative are located on opposite sides of a major drainage divide within the Valle de Resolucion (Figure 2). Ground water typically flows away from major topographic divides and the potentiometric surface (water

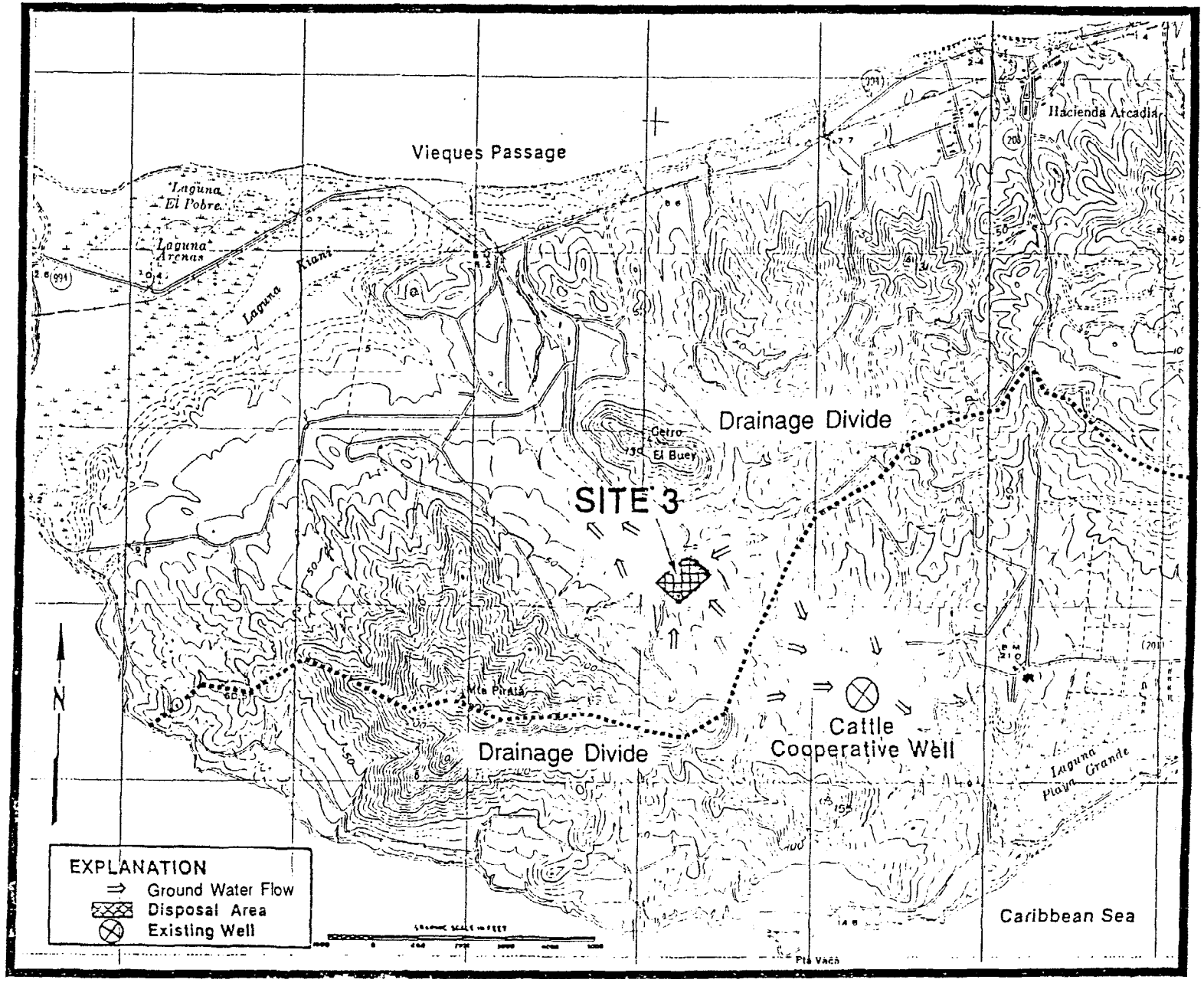

FIGURE 2
LOCATION OF SITE 3, THE IRFNA/MAF-4
DISPOSAL SITE, VIEQUES ISLAND

table) mimics the topographic surface. Because Site 3 is located northwest of the divide, ground water would flow towards Laguna Kiani, and away from the spring used by the cattlemen's cooperative. Nevertheless, the spring was sampled during the Confirmation Study to verify that the ground water used by the livestock had not been impacted.

Potential receptors in and around Vieques include such endangered species as the Caribbean manatee (Trichechus manatus) and the hawksbill, leatherback, green, and loggerhead sea turtles, all of which are found in the Vieques Passage.

CONFIRMATION STUDY

A confirmation study was recommended for this site based on the conclusions of the IAS. A ground-water sample from Cattlemen's Cooperative spring was collected and analyzed for all Priority Pollutants to determine whether the water source had been impacted. Because there was no visible evidence of stressed vegetation or other environmental degradation of the disposal area, and given the highly reactive nature of the fuel, no soil sampling was proposed.

RESULTS

During the IAS examination of the area where the fuel had been disposed, no areas of stressed vegetation or other indications of the incident were observed and reported. Observations recorded in previous reports indicated that livestock were seen drinking standing water in the area where fuel had been released. The site was visited by Versar and LANTDIV NAVFACENGCOM personnel during August 1990. No odors, stained soil, stressed vegetation, or other evidence of the MAF-4 fuel release could be discerned in vicinity of the site. Tropical vegetation was dense and healthy throughout the area surrounding Building 422.

A ground-water sample from the spring used by the cattle cooperative was taken during the Confirmation Study that indicated the concentrations of all metals (except zinc), volatile and semivolatile organic compounds, and pesticides/PCBs were below detection limits. The concentration of zinc detected (469 µg/l) was well below the National Secondary Drinking Water Standard of 5,000 µg/l. A review of the detection limits indicates that all contaminant concentrations were well below available applicable or relevant and appropriate environmental standards.

CONCLUSION

Analytical results from the ground-water sample collected from the cattlemen's cooperative spring indicated no contaminants are present in this water supply.

Hydrogeological information indicates that it is not possible for this spring to be impacted by disposal of the MAF-4/IRFNA fuel because of an intervening drainage divide.

The binary nature of the AQM-37A fuel does much to mitigate the environmental effects of a release of its two components when these components are mixed. Using hydrazine as a model for the composition of MAF-4, a mixture of the fuel's two components would be expected to react with each other spontaneously. Hydrazine (H_2NNH_2) is a very strong reducing agent; red fuming nitric acid is a strong oxidizer. When mixed, the reaction produces free nitrogen and water as follows:

$$H_2NNH_2 + 2HNO_3 \rightarrow 2N_2 \uparrow + 3H_2O.$$

In terms of the fuel mixture contained in the drones (71 lbs MAF-4 to 211 lbs IRFNA), there was more than an ample supply of IRFNA available to completely react the MAF-4. Given the reactivity of hydrazine and other hydrazine-derived rocket fuels, the MAF-4 would be expected to decompose in air as follows:

$$H_2NNH_2 + O_2 \rightarrow 2H_2O + N^2.$$

In both instances, the non-gaseous reaction product is simply water.

The information reported in the IAS that cattle were seen drinking surface water from puddles in the vicinity of the rocket fuel release strongly supports that the two binary components reacted and dissipated following disposal. Livestock would not be expected to even approach hydrazine-like compounds because the compound is a strong irritant to skin and eyes and highly toxic by ingestion, inhalation, or skin absorption. Similarly, cattle could not tolerate a highly concentrated acid such as the IRFNA. Any unreacted components are both highly soluble and are readily degraded by nitrogen seeking plants and indigenous bacteria.

Based on analytical results from the sample from the cattlemen's cooperative spring that indicate no contaminants are present, the chemistry of the fuel disposed, and the nature of ground-water flow within the Valle de Resolucion, no migration potential exists for the contaminants to move to sensitive environmental areas. Present day vegetation is thriving, and anecdotal information collected in interviews indicates that the fuel largely or completely reacted shortly after disposal. These findings indicate that the release poses no threat to human health or the environment. Versar therefore recommends no further action at this site is warranted.

Versar INC.

REFERENCES

Environmental Science and Engineering, 1988. Confirmation Study to Determine Possible Dispersion and Migration of Specific Chemicals. U.S. Naval Station Roosevelt Roads, Puerto Rico, and U.S. Naval Ammunition Facility Viques: prepared for Atlantic Division, Naval Facilities Engineering Command, Norfolk, Virginia. (Navy Contract No. N62470-85B-7972).

Greenleaf/Telesca Planners, Engineers, and Architects. 1986. Initial Assessment Study, Naval Station Roosevelt Roads, Puerto Rico: prepared in conjunction with Ecology and Environment, Inc. for U.S. Naval Energy and Environmental Support Activity (Navy Contract No. N62474-82C-C357).

Hawley, G.G. 1977. The Condensed Chemical Dictionary: Van Nostrand Reinhold Company, Ninth edition.

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APPENDIX

ANALYTICAL RESULTS (ESE, 1988)

PROJECT NUMBER 87488 0000 PROJECT NAME PUERTO RICO - NAF VIEQUES
FIELD GROUP VQPR3W PROJECT MANAGER RUSS BOWEN
VIEQUES SITE 3 WATERS LAB COORDINATOR LISA BARE

SAMPLE ID/#

PARAMETERS	UNITS	STORET #	METHOD	3PW01 VQPR3W 1
DATE				11/18/87
TIME				11:00
WATER TEMP	C	10	0	25.5
PH,FIELD	STD UNITS	400	0	7.90
SP.COND.,FIELD@25C	UMHOS/CM	94	0	895
BENZENE	UG/L	34030	GMS	<1.0
BROMODICHLOROMETHANE	UG/L	32101	GMS	<2.2
BROMOFORM	UG/L	32104	GMS	<4.7
BROMOMETHANE	UG/L	34413	GMS	<5.8
CARBON TETRACHLORIDE	UG/L	32102	GMS	<2.8
CHLOROBENZENE	UG/L	34301	GMS	<6.0
CHLOROETHANE	UG/L	34311	GMS	<8.2
2-CHLOROETHYLVINYL ETHER	UG/L	34576	GMS	<15
CHLOROFORM	UG/L	32106	GMS	<1.6
CHLOROMETHANE	UG/L	34418	GMS	<4.3
DIBROMOCHLOROMETHANE	UG/L	32105	GMS	<3.1
1,1-DICHLOROETHANE	UG/L	34496	GMS	<4.7
1,2-DICHLOROETHANE	UG/L	34531	GMS	<2.8
1,1-DICHLOROETHYLENE	UG/L	34501	GMS	<2.8
TRANS-1,2-DICHLORO ETHENE	UG/L	34546	GMS	<1.6
1,2-DICHLOROPROPANE	UG/L	34541	GMS	<6.0
CIS-1,3-DICHLORO PROPENE	UG/L	34704	GMS	<5.0

PROJECT NUMBER 87488 0000 PROJECT NAME PUERTO RICO - NAF VIEQUES
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VIEQUES SITE 3 WATERS LAB COORDINATOR LISA BARE

SAMPLE ID/#

PARAMETERS	UNITS	STORET #	METHOD	3PW01 VQPR3W 1
DATE				11/18/87
TIME				11:00
TRANS-1,3-DICHLORO PROPENE	UG/L	34699	GMS	<6.4
ETHYLBENZENE	UG/L	34371	GMS	<7.2
METHYLENE CHLORIDE	UG/L	34423	GMS	<50
1,1,2,2-TETRACHLORO ETHANE	UG/L	34516	GMS	<4.1
TETRACHLOROETHENE	UG/L	34475	GMS	<3.0
TOLUENE	UG/L	34010	GMS	<6.0
1,1,1-TRICHL'ETHANE	UG/L	34506	GMS	<3.8
1,1,2-TRICHL'ETHANE	UG/L	34511	GMS	<5.0
TRICHLOROETHENE	UG/L	39180	GMS	<1.0
TRICHLOROFLUORO-METHANE	UG/L	34488	GMS	<3.2
VINYL CHLORIDE	UG/L	39175	GMS	<1.0
ACENAPHTHENE	UG/L	34205	GMS	<1.0
ACENAPHTHYLENE	UG/L	34200	GMS	<1.0
ANTHRACENE	UG/L	34220	GMS	<1.0
BENZIDINE	UG/L	39120	GMS	<2.1
BENZO(A)ANTHRACENE	UG/L	34526	GMS	<1.0
BENZO(B)FLUORANTHENE	UG/L	34230	GMS	<1.5
BENZO(K)FLUORANTHENE	UG/L	34242	GMS	<1.5
BENZO(A)PYRENE	UG/L	34247	GMS	<1.5
BENZO(GHI)PERYLENE	UG/L	34521	GMS	<2.0

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SAMPLE ID/#

PARAMETERS	UNITS	STORET #	METHOD	3PW01 VQPR3W 1
DATE				11/18/87
TIME				11:00
BUTYLBENZYLPHTHALATE	UG/L	34292	GMS	<1.0
BIS(2-CHLOROETHYL) ETHER	UG/L	34273	GMS	<1.0
BIS(2-CHLOROETHOXY) METHANE	UG/L	34278	GMS	<1.0
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	39100	GMS	<1.0
BIS(2-CHL'ISOPROPYL) ETHER	UG/L	34283	GMS	<1.0
4-BROMOPHENYLPHENYL ETHER	UG/L	34636	GMS	<1.0
2-CHLORONAPHTHALENE	UG/L	34581	GMS	<1.0
2-CHLOROPHENOL	UG/L	34586	GMS	<1.7
4-CHLORO-3-METHYL PHENOL	UG/L	34452	GMS	<1.4
4-CHLOROPHENYLPHENYL ETHER	UG/L	34641	GMS	<1.0
CHRYSENE	UG/L	34320	GMS	<1.0
DIBEN'(A,H)ANTH'CENE	UG/L	34556	GMS	<2.0
DI-N-BUTYLPHTHALATE	UG/L	39110	GMS	<1.0
1,3-DICHLOROBENZENE	UG/L	34566	GMS	<1.0
1,2-DICHLOROBENZENE	UG/L	34536	GMS	<1.0
1,4-DICHLOROBENZENE	UG/L	34571	GMS	<1.0
3,3'-DICHL'BENZIDINE	UG/L	34631	GMS	<1.5
2,4-DICHLOROPHENOL	UG/L	34601	GMS	<1.4
DIETHYLPHTHALATE	UG/L	34336	GMS	<1.0
2,4-DIMETHYLPHENOL	UG/L	34606	GMS	<1.4

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SAMPLE ID/#

PARAMETERS	STORET #	3PW01 VQPR3W
UNITS	METHOD	1
DATE		11/18/87
TIME		11:00
DIMETHYLPTHALATE	34341	<1.0
UG/L	GMS	
2,4-DINITROPHENOL	34616	<30
UG/L	GMS	
2,4-DINITROTOLUENE	34611	<1.0
UG/L	GMS	
2,6-DINITROTOLUENE	34626	<1.0
UG/L	GMS	
DI-N-OCTYLPHTHALATE	34596	<1.1
UG/L	GMS	
FLUORANTHENE	34376	<1.0
UG/L	GMS	
FLUORENE	34381	<1.0
UG/L	GMS	
HEXACHLOROBENZENE	39700	<1.0
UG/L	GMS	
HEXACHLOROBUTADIENE	34391	<1.0
UG/L	GMS	
HEXACHLOROCYCLOPENTA	34386	<2.0
DIENE UG/L	GMS	
HEXACHLOROETHANE	34396	<1.5
UG/L	GMS	
INDENO(1,2,3-CD)	34403	<2.0
PYRENE UG/L	GMS	
ISOPHORONE	34408	<1.0
UG/L	GMS	
2-METHYL-4,6-DINITRO	34657	<5.0
PHENOL UG/L	GMS	
NAPHTHALENE	34696	<1.0
UG/L	GMS	
NITROBENZENE	34447	<1.0
UG/L	GMS	
2-NITROPHENOL	34591	<1.4
UG/L	GMS	
4-NITROPHENOL	34646	<3.3
UG/L	GMS	
N-NITROSODIMET'AMINE	34438	<1.0
UG/L	GMS	
N-NITROSODI-N-PROPYL	34428	<1.0
AMINE UG/L	GMS	

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SAMPLE ID/#

PARAMETERS	STORET #	3PW01 VQPR3W
UNITS	METHOD	1
DATE		11/18/87
TIME		11:00
N-NITROSODIPHE'AMINE	34433	<1.0
UG/L	GMS	
PENTACHLOROPHENOL	39032	<10
UG/L	GMS	
PHENANTHRENE	34461	<1.0
UG/L	GMS	
PHENOL	34694	<1.3
UG/L	GMS	
PYRENE	34469	<1.0
UG/L	GMS	
1,2,4-TRICH'BENZENE	34551	<1.0
UG/L	GMS	
2,4,6-TRICHL'PHENOL	34621	<1.8
UG/L	GMS	
ALDRIN	39330	<0.005
UG/L	EC	
BHC,A	39337	<0.005
UG/L	EC	
BHC,B	39338	<0.005
UG/L	EC	
BHC,D	34259	<0.005
UG/L	EC	
BHC,G(LINDANE)	39340	<0.005
UG/L	EC	
CHLORDANE	39350	<0.006
UG/L	EC	
DDD,PP'	39310	<0.005
UG/L	EC	
DDE,PP'	39320	<0.005
UG/L	EC	
DDT,PP'	39300	<0.005
UG/L	EC	
DIELDRIN	39380	<0.005
UG/L	EC	
ENDOSULFAN,A	34361	<0.005
UG/L	EC	
ENDOSULFAN,B	34356	<0.005
UG/L	EC	
ENDOSULFAN SULFATE	34351	<0.005
UG/L	EC	

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PARAMETERS	STORET #	SAMPLE ID/# 3PW01
UNITS	METHOD	VQPR3W 1
DATE		11/18/87
TIME		11:00
ENDRIN	39390	<0.005
UG/L	EC	
ENDRIN ALDEHYDE	34366	<0.005
UG/L	EC	
HEPTACHLOR	39410	<0.047
UG/L	EC	
HEPTACHLOR EPOXIDE	39420	<0.005
UG/L	EC	
TOXAPHENE	39400	<0.600
UG/L	EC	
PCB-1016	34671	<0.121
UG/L	EC	
PCB-1221	39488	<0.121
UG/L	EC	
PCB-1232	39492	<0.121
UG/L	EC	
PCB-1242	39496	<0.121
UG/L	EC	
PCB 1248	39500	<0.121
UG/L	EC	
PCB-1254	39504	<0.121
UG/L	EC	
PCB-1260	39508	<0.121
UG/L	EC	
ANTIMONY, TOTAL	1097	<39.0
UG/L	ICAP	
ARSENIC, TOTAL	1002	<1.6
UG/L	GFAA	
BERYLLIUM, TOTAL	1012	<2.9
UG/L	ICAP	
CADMIUM, TOTAL	1027	<2.3
UG/L	ICAP	
CHROMIUM, TOTAL	1034	<7.6
UG/L	ICAP	
COPPER, TOTAL	1042	<10.0
UG/L	ICAP	
LEAD, TOTAL	1051	<34.0
UG/L	ICAP	
MERCURY, TOTAL	71900	<0.2
UG/L	CVAA	

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PARAMETERS	STORET #	3PW01 VQPR3W
UNITS	METHOD	1
DATE		11/18/87
TIME		11:00
NICKEL,TOTAL	1067	<33.0
UG/L	ICAP	
SELENIUM,TOTAL	1147	<2.5
UG/L	GFAA	
SILVER,TOTAL	1077	<2.7
UG/L	ICAP	
THALLIUM,TOTAL	1059	<2.8
UG/L	GFAA	
ZINC,TOTAL	1092	469
UG/L	ICAP	
PHENOLS	32730	<2
UG/L	1	